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The Consultancy with a University at its Service

by D. J. Spikins,
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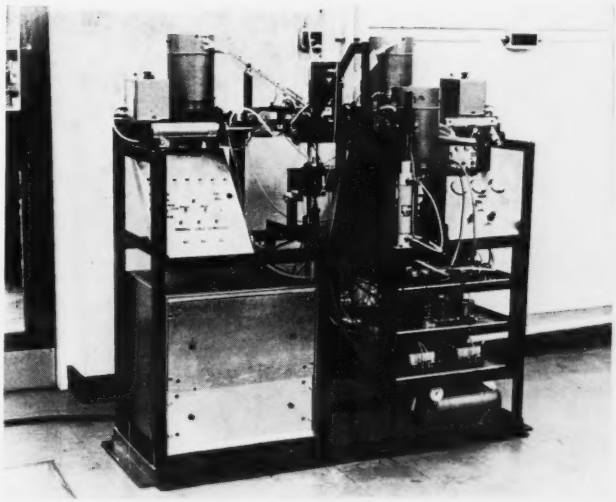
Loughborough Consultants

In the staff and equipment of its various faculties, a university has at its disposal a range of know-how, expertise and specialist facilities which very few industrial organisations can match. They are there to satisfy the requirements of its teaching and research functions; and by virtue of these same functions a university is also a fruitful source of ideas and innovation. Science and technology faculties have therefore much to offer industry, in addition, of course, to supplying it with graduates. Nobody nowadays can accuse the universities of an Ivory Tower attitude, since their role in the community, and indeed their teaching and research functions, have long demanded close and continuous contact with the problems and needs of industry. The universities keep in touch with industry by sponsored research and consultancy, but until fairly recently the latter has usually been restricted solely to the provision of advice, mainly in particular disciplines. Now, however, the scope of consultancy work is gradually being widened to encompass all the expertise and facilities of the university—providing a 'package consultancy', as it were, which can reach out to any department for the combination of know-how required to solve a given problem, and which, if necessary, can even undertake contracts entailing start-to-finish work on complete design and/or construction projects. Loughborough University of Technology was the first to offer such a consultancy, recognising that the work would be of benefit both to itself and to the client firm; after all, the firm gets its problem solved: the 'academic' maintains contact with industry and has the chance of applying his ideas under actual service conditions: and the student gets the opportunity to see the relevance of his course to his chosen profession. For efficient co-ordination of the whole operation, some organisation has to act as entrepreneur between industry and university, and at Loughborough University we in Loughborough Consultants provide this service.

Loughborough Consultants Ltd. was set up in July 1969, as a company limited by guarantee, with a Board of Directors drawn from local industry and the University. Nearly all the Directors are members of the Council of the University, and for all practical purposes, therefore, control is in the hands of the University. The company receives no subsidies, and hence from the outset we had to cover our operating costs by fees from consultancy and project work. Moreover, since the making of a profit is a fair indication of efficiency, the Board decided not only that we should be self-supporting but also that overall we should show a moderate profit. In our first year we broke even with an income of £40,000 (ensuring our independence from University financing); in the second, our income increased to £100,000, and we made a profit of £3,000; and this year our turnover is expected to show a further substantial increase.



A prototype high-speed automatic assembly machine developed by Loughborough Consultants.

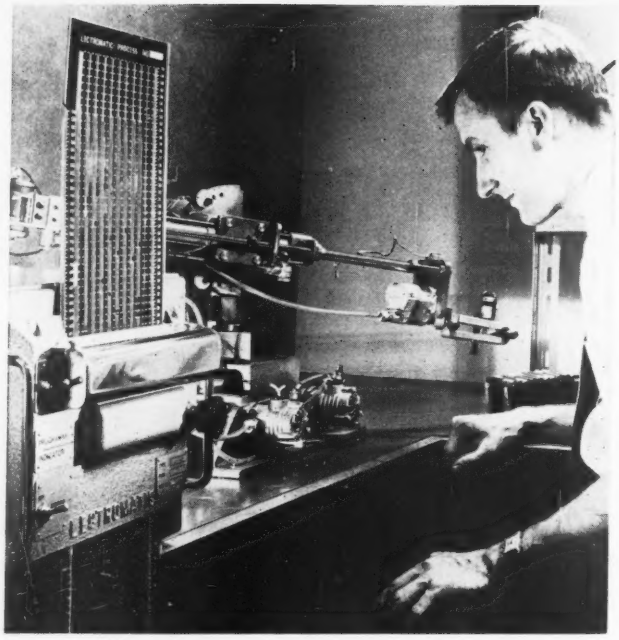
Spheres of activity

Loughborough Consultants' work can be divided into the following three main areas of activity:

1. Easily the most important are the projects undertaken for clients on a customer/contractor basis. In the 2½ years since our formation we have received some 300 inquiries about project work; 180 of the inquiries were converted into formal proposals of work; and, of the proposals, 152 were accepted. If our experience is anything to go by, therefore, any university offering its services in a professional and commercial manner will meet with an enthusiastic response from industry.

On several projects, and in one particular area of expertise, the demands made by clients have threatened to strain the University's resources beyond the point at which academic efficiency would be impaired, and we have therefore engaged a nucleus of full-time staff for secondment to University departments needing assistance to ease the work load. At present we have some 25 employees of this type, involved in engineering design, computer work, information services and noise research, all of whom are available to the Head of the academic department once their commitment to Loughborough Consultants is fulfilled.

2. Our second function is as a vehicle for promoting activities which academic departments feel would be best handled by a formal organisation such as ours. One example is the Particle



A mechanical hand being operated by program in Loughborough University's Department of Engineering Production.

Science and Technology Information Service, which provides a monthly current-titles bulletin to some 60 subscribers, and undertakes literature reviews in the field of particle technology. The Service is managed by Loughborough Consultants, while the technical work is conducted within the Department of Chemical Engineering. LUCID (Loughborough University Computerised Information and Drawing)—a co-operative project set up to develop a new means of presenting data relevant to the construction industry, and funded by 100 organisations connected with the industry—is another venture managed by us. LUCID, however, relies heavily for its efficiency on Working Parties manned by staff from the subscribing organisations, and the whole organisation is controlled by a Steering Committee which acts through a Technical Advisory Committee to which the Working Parties report.

3. Our third area of activity—one which, because of our haste to achieve commercial viability, has received least attention—is exploitation of patents and innovation. We could not possibly survive on a commercial basis solely by exploiting inventions, but the University is a cornucopia of ideas, and, since many of these are worthy of development, Loughborough Consultants has taken on the task of doing so. We pay the cost of obtaining provisional patents, we try to find sponsors for further development and licensees for inventions, and we sometimes assist members of the University wishing to undertake major development programmes, such as that promoting innovation in the civil fire service by the development of a design for a new fire appliance.

Typical projects

So far our services have been sought mainly by two types of company: the medium-size company capable of supporting a major development contract but with limited technical resources; and the large company wishing to supplement its own resources or to make use of the services of a specialist in an area in which it has limited expertise. Our clients include many firms whose names are household words (eg, Marks and Spencer, Rolls Royce, Tracked Hovercraft, the National Coal Board and Pilkington Brothers), and a great deal of work has also been undertaken for local authorities (eg, Surrey County Council, Kent County Council) requiring short-term technical assistance. Though we have as yet made no attempt to seek work abroad, our clients include organisations from Israel, Germany, the USA and Holland.

I can give some idea of the types of work with which we have been involved by citing examples of test programmes and design and development projects, and by referring to our growing reputation as a source of technical experts for the legal profession, the insurance companies and industry. Tests have been conducted on materials and components as varied as lubricating-oil additives, automotive engines and hydraulic models of civil-engineering works. Hardware designed, developed and constructed within our consultancy includes equipment for British Rail's Advanced Passenger Train, and a packaging machine on which the Engineering Design Centre has been working for the last 18 months. A prototype packaging machine is now being further developed, preparatory to building a pre-production prototype for factory installation, and, after completion of this work, the aim will be to produce a second-generation machine with greater capability and versatility. In another project members of the Transport Technology Department have been engaged in design studies on the emergency suspension system for the Hovertrain. Many of the other contracts accepted over the last two years have however, been more mundane, though all of them have served our main purpose—to maintain the interest of academic staff in the current problems of the industries for which they are training undergraduates and doing research work.

The provision of technical experts and witnesses is a small but very important facet of our involvement with the professions. A technical expert must not only have wide experience in his field, but also be capable of getting his technical knowledge over to the people, often laymen to the field, who have to make their decisions on the basis of his advice. Consequently, we expend a great deal of effort in ensuring that our expert matches up as much as possible to the requirements of the particular case. One aspect of this type of activity which is expected to expand considerably in future is that of preparing evidence for planning enquiries. The University's Noise Studies Group, in particular, has acquired a good deal of experience as expert witnesses. It has, for example, supplied noise contours on the proposed Third-London-Airport sites for submission to the Roskill Commission by the British Airports Authority, and provided technical advice on the noise effects of several new motorway and urban ring-road systems. It is currently working on various industrial noise problems.

The future

How the pattern of our work is likely to evolve in the future can to some extent be foreseen. For example, the size of individual contracts is likely to increase (though this will not, of course, diminish in any way our welcome for small contracts), and the exploitation of University inventions will probably play a larger part in our activities. Whatever the trend, however, we feel that at Loughborough we have developed a successful formula for co-operation with industry, which is capable of being adapted, as necessary, to the changing needs of the community.

All the work we undertake is carried out in complete confidence. Preliminary meetings to define the problem and establish the method of solution are held at no cost to the client, and the client assumes obligations only when he accepts our proposals. Such questions as costs, patent rights and completion dates are always agreed during the preliminary meetings.

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The Harmonisation of Wood-Preservative Testing

by J. M. Baker, Building Research Establishment, Princes Risborough Laboratory

SINCE 1964, Working Group 38 of the European Committee for Standardisation (the CEN)—a Group comprising representatives of the national standards organisations of nine European countries—has been engaged in harmonising the multiplicity of test methods used by member countries to assess the performance of wood preservatives against the insects and decay organisms which cause deterioration of unprotected timber.

Scientific evaluation of the action of preservatives by laboratory test methods started about the turn of the century in Germany and America, and was concerned almost entirely with protection against fungal decay. By the 1930s a number of countries, including the UK, were producing national standards in this field, though equivalent tests for the effectiveness of preservatives against insect attack in timber were started considerably later, with the first national standards appearing in 1949 and the first British Standards in 1963. The test methods adopted in different countries varied, partly because of the separate development of the science of wood preservation in each, but, more practically, because there was a deliberate attempt to make each test relate as closely as possible to actual field conditions, and, of course, these differed in different parts of Europe. The data obtained from laboratory preservative testing are of great value, not only to the manufacturer in developing or improving a product, but also to the user, or the official body acting on his behalf, in checking that the performance of a preservative is adequate to his needs. In countries which have an official approval scheme for wood preservatives (eg, France and Germany) the results of standard laboratory tests are the chief factor taken into account by the approval organisations in determining the use for which a product may be registered. These organisations build up a valuable corpus of experience based on test results, and, clearly, any variation in the methodology which affects the interpretation of results can cause difficulty to an approval scheme.

The harmonisation of wood-preservative test methods from different countries is therefore by no means a formality, but an exercise requiring a great deal of technical work and calling for a spirit of give and take on the part of the national standards organisations concerned.

The harmonised standards

Working Group 38 of the CEN has now reached the stage where all unification work on seven test methods dealing with the common European timber insects has been completed and unification documents have been published. The first three European standards should be completed this year. To understand why there are seven different test methods for assessing preservatives in this field, it is necessary to consider the basic characteristics of wood-boring insect attack. The chief insects causing economic damage in buildings in Europe are:

the house-longhorn beetle, *Hylotrupes bajulus*, common throughout parts of Europe with a warm Continental summer, but occurring only in isolated localities in England and Scandinavia;
the common furniture beetle, occurring throughout Europe, but most prevalent in regions with an Atlantic climate;
the powder-post beetle, *Lyctus*, which has an almost worldwide distribution and is found in all parts of Europe.

CEN standards covering wood-preservative tests

No	Abbreviated title	Previous equivalent British Standard
38/U1	Insecticidal activity against *Lyctus brunneus*	BS 3653:1963
38/U2	Determination of toxic values against *Anobium punctatum* by larval transfer	BS 3651:1963 (in part)
38/U3	Toxicity to freshly hatched larvae of *Hylotrupes bajulus*	None
38/U4	Determination of toxic values against *Hylotrupes bajulus*	BS 3651:1963 (in part)
38/U5	Curative action against *Anobium punctatum* larvae	None
38/U6	Determination of toxic values against *Anobium punctatum* by egg-laying and larval survival	BS 3652:1963
38/U7	Determination of toxic values against wood-destroying fungi (*Basidiomycetes*)—Unification Report	BS 838:1961 (still current)
38/U8	Curative action against *Hylotrupes bajulus*	None

These insects commence their attack by laying eggs on or under the surface of unprotected wood. The eggs hatch into grubs or larvae, which tunnel in the wood, using it as a foodstuff, and eventually change into beetles. The beetles finally emerge from the wood and continue the cycle. The laboratory tests standardised by CEN for use with these insects are listed in the table above, together with the British Standards which they will eventually supersede. They fall into three categories:

(1) Tests of the ability of sound wood, when treated with surface applications of the preservative, to resist onset of infestation. There are two tests of this type. U1 looks at the ability of a preservative to confer resistance to attack by *Lyctus*, when treated wood is exposed to attack by adult beetles. It is a simple test, giving an overall indication of the effectiveness of a surface-applied preservative (especially with respect to protection of hardwoods), and it is suitable for use as a screening test. U3 fulfils a similar function for softwoods and the protection afforded by a surface application against attack by the house-longhorn beetle. It is quick and easy to carry out, and is widely used in Europe as a first indication of the effectiveness of a preservative formulation for use in pretreating timber in buildings.

(2) More specific tests to indicate the concentration of insecticide in the wood necessary to kill the insect at a given stage in its life cycle. In the three standardised tests falling into this category, wood blocks are carefully impregnated with a series of concentrations of insecticide, and the solvent is removed under standard conditions to leave known retentions of insecticide in the wood. Insects are then introduced into these blocks, and the concentration just sufficient to kill them is determined. This concentration, and that next lowest in the series which just allows survival, are referred to as the *toxic values* or *toxic limits* of that insecticide in the test wood. Although the Standard does not provide for it, tests of this type are suitable also for more rigorous statistical analysis. Two of the three tests—U2 and U4—provide for the artificial insertion of larvae (of the common furniture beetle and house-longhorn beetle, respectively) into predrilled holes in the treated blocks. In the third test—U6—the treated blocks are exposed to egg-laying by the common furniture beetle. The tests in this group give results which cannot be directly applied in practice, but which allow precise comparisons between different materials and measurements of the loss of preservatives due to ageing by evaporation or leaching; the results are hence of great value in building up a picture of the likely effectiveness of an insecticide. Although the test with egg-laying by the common furniture beetle would appear at first sight to be the most realistic, it is

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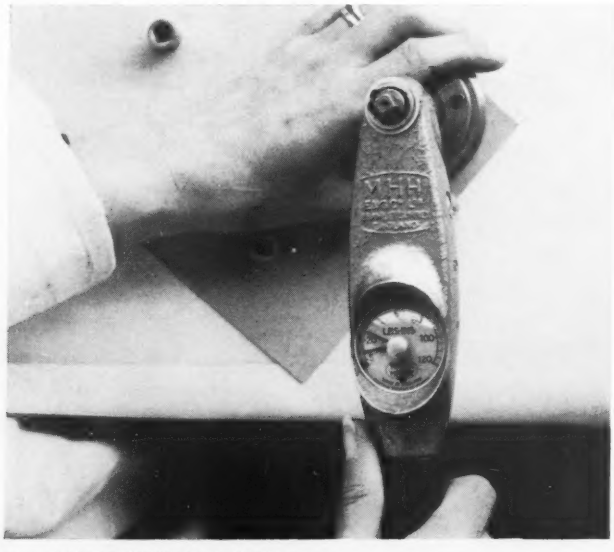
The Adhesion of Organic Coatings to Metals

by P. Walker,
Atomic Weapons Research Establishment, Aldermaston

A basic, if obvious, requirement for any paint system designed to protect a metal structure is that it adhere to its substrate: clearly, if it becomes detached, it cannot protect. Good adhesion is a phrase often bandied about in discussing paint, but what qualifies as 'good' in this respect is seldom defined, and no threshold value has ever been suggested above which the adhesion of a paint can be considered satisfactory, or below which it is likely to fail in service. In effect, the problem boils down to ensuring that the adhesion of the paint is high enough to withstand both the external forces imposed upon it by the service environment, and the internal forces occurring within the film as a result of dimensional changes due to the curing process and progressive deterioration. Deterioration can be caused either by exposure to such hostile agencies as ultraviolet radiation, oxygen, water and heat or cold, or (a factor which is particularly important in the case of such metals as zinc and cadmium) by interaction with the metallic substrate.

It is not easy to assess the adhesion of a coating, especially if meaningful values are to be attached to the observations. Many of the test methods proposed for this purpose require artificially prepared substrates coated under precise laboratory conditions; others are completely subjective—virtually 'go/no-go' tests, in which adhesion is assessed by scratching the painted specimen or by hitting it with a sharp object. The 'cross-hatch and tape' is, however, one test which has proved useful and is often employed. It involves scoring a series of eleven parallel lines through the film to the substrate, and a further eleven at right angles to the originals, so producing a pattern of a hundred small squares. A length of suitable adhesive tape is then smoothed over the squares and removed with a swift pull. If the adhesive is inadequate, the paint squares are detached, and and a numerical representation of adhesion can be assigned by counting the squares (if any) remaining, and so obtaining a percentage value. Still more objective, however, is a test—known as the 'torque-spanner' test—recently developed by the United Kingdom Atomic Energy Authority. In this test (see figure below) a cylindrical steel piece is bonded to the paint surface by means of a suitable adhesive, and then twisted off, using a recording torque spanner. Knowing the area of contact, the direct lb-in reading so obtained can be converted to a direct adhesion value in lbf/in^2. The test can be applied to almost any painted object which has a small plane surface, and can hence be used to test the adhesion of coatings under service conditions; though, for a valid assessment of overall adhesion, the point of failure of the paint film has to be taken into account in addition to the adhesion value. In a multicoat paint system there are several points of potential failure, of which the most important are failure of the paint to adhere to the metal surface, and clean separation of one coat from another. Cohesive failures within a paint layer are of less importance, and are preferable to adhesion failures.

The adhesion of a paint coating to its substrate being evaluated by means of AWRE's 'torque-spanner' test.



The effect of the metal

Typical adhesion values established for some types of paint coating on various metallic substrates are shown in Table 1. In general, adhesion is high, though it varies from metal to metal, particularly in the case of those paints which cure by reaction with atmospheric oxygen. Paints of this type, which include the long-oil alkyd and the short-oil epoxide ester, liberate short-chain fatty acids (such as formic, propionic and butyric acid) which may react with certain metals to produce brittle low-adherent reaction products at the paint-metal interface. These reaction products lower adhesion, both when the coating is first applied and during subsequent service, and can eventually lead to complete loss of adhesion. The familiar loss of adhesion of paint on galvanised window frames and garage doors is often due to this effect: the coating becomes embrittled and chips readily, and eventually flakes away exposing the base metal.

To minimise or eliminate this metal/paint reaction, a paint has to be used which is non-reactive to zinc, or a coating has to be applied as a barrier between the reactive paint and the metal. A good barrier is achieved by applying an etch primer to the metal surface. Probably the most effective paint for use on zinc is a primer based on the buff-coloured low-opacity pigment, calcium plumbate, which confers very effective protection and excellent adhesion. Cadmium and brass are almost as reactive as zinc, and hence also difficult to paint.

In addition to the type of paint and the metal to be painted, there are other factors which have just as important an effect on adhesion, including the presence of surface contamination (eg, grease, oil, dirt or rolling lubricants), the state of preparation of the surface to be painted, the environment at the time of painting, and the service conditions. These factors are considered below.

The effect of surface preparation

Surface preparation can improve the adhesion of surface coatings by removing contamination, such as grease or rolling lubricants; by removing friable or loose oxides or scale; or by chemically modifying the surface by producing a controlled oxide or phosphate layer.

The removal of surface contamination is usually carried out by solvent washing, solvent vapour extraction or by mild alkali washing followed by a water rinse. The solvent used should, of course, be appropriate to the type of contaminant present. The removal of loose oxide is particularly important in the case of hot-rolled structural steel on which millscale is present. The scale *must* be removed (either mechanically or by acid pickling) before painting, since broken millscale leads to rapid underfilm rusting, loss of adhesion and subsequent

Table 1. Adhesion of paints to various metal substrates

Coating	Steel		Aluminium		Brass		Cadmium (passivated)		Zinc	
	Adhesion lbf./in.²	Site of failure	Adhesion lbf./in.²	Site of failure	Adhesion lbf./in.²	Site of failure	Adhesion lbf./in.²	Site of failure	Adhesion lbf./in.²	Site of failure
Long-oil alkyd paint	3,500	Cohesive failure in paint	3,600	Cohesive failure in paint	2,930	100% adhesion from metal	2,090	100% adhesion from metal	2,600	100% adhesion from metal
Chlorinated-rubber paint	3,700	Cohesive failure in paint	3,820	Cohesive failure in paint	3,750	Cohesive failure in paint	3,300	Cohesive failure in paint	3,650	Cohesive failure in paint
Short-oil epoxide ester paint	4,800	Cohesive failure in paint	4,700	Cohesive failure in paint	3,050	100% adhesion from metal	3,800	100% adhesion from metal	3,200	100% adhesion from metal
Polyurethane paint (two-pack)	3,600	50% adhesion from metal	3,500	70% adhesion from metal	4,100	30% adhesion from metal	4,800	No failure	3,100	50% adhesion from metal
Epoxide paint (two-pack)	4,540	30% adhesion from metal	4,850	40% adhesion from metal	3,300	100% adhesion from metal	4,800	No failure	3,450	60% adhesion from metal
Etch primer	4,500	Cohesive failure in paint	4,500	Cohesive failure in paint	5,100	Cohesive failure in paint	4,900	Cohesive failure in primer	4,800	Cohesive failure in primer

flaking. The effect of mechanical cleaning is shown in Table 2. The data, which were derived from adhesion tests in which a typical zinc-silicate primer was applied to mild-steel specimens prepared in three different ways, show that wire brushing is not nearly as effective as grit-blasting. Similar results have been obtained in tests with aluminium. In this case a solvent wash increased the measured adhesion from approximately 1,600 lbf./in.² to almost 3,000 lbf./in.², and the use of a wash primer resulted in an adhesion value of 4,500 lbf./in.².

Table 2. Influence of surface preparation on the adhesion of paint to steel

Surface preparation	Adhesion lbf./in.²	Site of failure (% of area)
Pickled, weathered and wire brushed	2,320	60% adhesion from metal 40% cohesion failure in paint
Commercial-standard grit blasting	4,130	5% adhesion from metal 95% cohesion failure in paint
White-metal-standard grit blasting	4,520	100% cohesion failure in paint

Effect of environment during application of the coating

It is not generally appreciated that adverse weather conditions can have a very damaging effect on the adhesion and cohesive strength of many coatings. People often think that, provided the surface is not actually wet during painting, no harm is done. This is certainly not the case, and particularly not the case with many of the newer, more sophisticated coatings of epoxide and polyurethane type. In general, paint coatings should not be applied if the relative humidity is more than 70-80 per cent or the temperature below 8-10°C. The restriction on relative humidity is an onerous one, for this level of humidity is common over much of the British Isles for long periods of the year, and it is therefore perhaps not unfair to say that much of the paint applied to structural steel in this country is applied under less than ideal conditions. Some idea of the damage caused by painting in a high humidity is illustrated in Table 3. The substrate was mild steel prepared to white-metal standard. The outstanding coating here is the wash primer, which is unaffected by high humidity, though this result is hardly surprising in view of the fact that the primer was formulated specially for application to ships under dry-dock conditions.

Table 3. Comparison of the adhesion of coatings applied under normal and wet conditions

Coating	40-50% R.H. adhesion/area removed	80-90% R.H. adhesion/area removed
Alkyd gloss finish	3,150/0	2,510/100
Two-pack epoxide finish	4,400/3	2,750/100
Two-pack polyurethane	3,450/20	1,050/100
Vinyl paint	2,130/5	1,850/70
Wash primer	4,650/0	4,320/0

The effect of the service environment

Water, whether in liquid or vapour form, has one of the most damaging effects on the adhesion of coatings to metal. Many coatings of the oxidative-cure type (alkyds, epoxide esters, oleoresinous) are very susceptible to attack by water vapour, and in conditions of high humidity—say, 80 per cent relative humidity and above—the loss of adhesion may be dramatic. At 90 per cent relative humidity, for example, a typical alkyd-resin-based paint may lose up to 50 per cent of its adhesion within 48 hours, and under saturated conditions more than 80 per cent of its adhesion, though, fortunately, the loss is very often recovered to a great extent when the humidity decreases. Coatings which dry by solvent evaporation—non-convertible coatings, as they are called—are not so badly affected, and loss of adhesion does not become significant until the relative humidity reaches 90 per cent. Chlorinated-rubber-based paints are very good in this respect (hence their extensive use in breweries, swimming baths, etc.), and stoving systems based on acrylic resins and melamine and urea/alkyd combinations are also largely insensitive to water.

When totally immersed in water, all coatings show some loss of adhesion, and in many cases 'wet adhesion' is only of the order of 10 per cent of 'dry adhesion'. The decrease in adhesion occurs in both fresh water and sea-water, but is slightly more rapid in fresh water. Paints showing the greatest resistance to the effects of immersion are those based on chlorinated rubber, some epoxide systems and thermosetting acrylics. The dilemma is that paint systems are required to be at their most protective when they are in most cases least adherent, and this loss of adhesion under water-soaked conditions is a reason why ships can be seen with large areas of paint stripped from their bow sections and why the paint on a motor car chips and flakes most during the winter months. Modern technology is endeavouring to resolve this dilemma by developing more suitable polymers, paint systems and surface-preparation procedures.

To summarise, it should be remembered that failure to select the correct coating for a given metal or environment, or inattention to surface preparation or weather conditions, may lead to premature loss of adhesion, general breakdown of the coating, and a costly repaint, with consequent loss of customer trust and good will.

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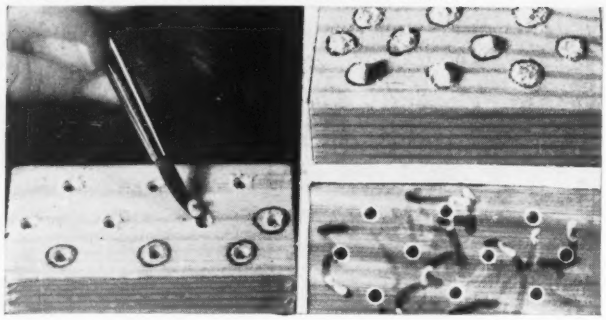

U2 Anobium *larval-transfer test. Left: Insertion of larva. Top right: Larvae established in control block. Bottom right: Radiograph of control block at end of test.*

somewhat difficult and time-consuming to perform, and interpretation of the results is not always straightforward. For practical reasons, therefore, assessments of toxic values are generally made from the test based on introduction of larvae.

(3) Tests of the ability of a preservative to destroy insects present within infested wood (the so-called eradicant action of a formulation). The two tests in this group are designed to give a practical evaluation of liquid insecticides used for the eradication of existing attack in timber in buildings. In the tests, larvae are allowed to become thoroughly established in the test blocks, and the test liquid is then applied at a rate simulating that occurring in practice. After a given interval of time, the kill of larvae in the wood is assessed. Test U5 deals with the common furniture beetle and U8 with the house-longhorn beetle. U8, in particular, has taken many years' work to harmonise, because the tests carried out in different countries differed so radically from one another, due principally to differences in building practice. Extensive laboratory research was necessary to check the comparability of different methods and to arrive at an acceptable compromise.

In addition to detailing the test methods themselves, the unification documents give a great deal of biological information on the rearing and laboratory use of the test insects—information that is not readily available elsewhere. This set of documents will, in due course, become definitive European standards, and will be accepted by the subscribing national standards institutes, including the British Standards Institution. It is hoped that they will be of considerable value in furthering international trade in preservatives between the different countries, and in ensuring that the best practices of each country become more widely diffused among all the subscribing member countries.

Future work

Further work is in progress on a test method for use with termites and on ancillary wood-preservative tests dealing with resistance to ageing. Work is also well advanced on a laboratory test for protection against wet-rot and dry-rot types of fungal decay found in buildings where wood is allowed to become wetted. However, in this field the differences between national standards are so profound, and the loss of information which would result in each country if its standard test were suddenly radically changed are so great, that a harmonised standard is still some way off. What **has** been achieved is a unification report which sets out the areas of agreement and draws separate national standards together as much as possible, but without, as yet, forming the basis of a common European standard. However, work continues in this field and is also beginning on other tests dealing with fungal decay.

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INSPEC: IEE's Computerised Information Service

DESPITE the increasing difficulties experienced by scientists and engineers in keeping abreast of the mass of technical material published, there are still only a handful of bibliographical information services which might be described as comprehensive and universal. And all but a few of the English-language systems are American. An exception is the British INSPEC (Information Services in Physics, Electrotechnology, Computers and Control) operated by the Institution of Electrical Engineers.

INSPEC has taken as its starting point the IEE family of abstract journals—already accepted as the principal English-language information service in its subject fields—and on them is building what is claimed to be the most comprehensive bibliographical data base in physics and electrical engineering. From this data base INSPEC derives its range of abstract publications, which are now computer-produced, and provides selective information dissemination services (SDI). It also dispenses magnetic-tape and microfiche versions of the data base to other information dissemination centres throughout the world. New services are in the process of being developed.

INSPEC complements other abstracting services—*Chemical Abstracts*, *Biological Abstracts*, and (in the medical field) *MEDLARS* and *Excerpta Medica*. It is also agent for other complementary systems—UK, Europe and Commonwealth (except Canada) agent for the American Institute of Physics' *Current Physics Information*, and the UK agent for the Washington-based Smithsonian Scientific Information Exchange and the United Kingdom Atomic Energy Authority's Harwell-based magnetic-tape and SDI services in nuclear science and technology.

Over 80 per cent of INSPEC products go to other countries—mainly the USA—and last year export earnings were more than £665,000.

The heart of INSPEC's integrated system is an ICL 1902A computer. Currently over 500 items are added to the data base every day, culled from over 12,000 sources a year—some 2,000 journals, 4,000 reports, 2,500 university theses, 3,000 patents, 300 books and 500 conference proceedings, from 47 countries in dozens of languages. Over 148,000 items were added in 1971, and 140,000 the previous year, bringing the size of the data bank held in machine-readable form since its inception in 1969 to 360,000 items.

The production system is based on a single central Current File of items that have not yet reached the publication stage. Each passes through a process of acquisition, selection, indexing, classification and editing at the hands of 40 information scientists, permanent INSPEC staff, backed by 400 outside occasional contributors. After keyboarding and proof-reading, the 10,000 to 12,000 abstracts under processing at any one time are ready for publication in various forms.

Chief of these are the abstracts: *Physics Abstracts*, with about 200 classified subject codes, published fortnightly; *Electrical & Electronics Abstracts*, with 200 codes, monthly; and *Computer & Control Abstracts*, with about 50 codes, monthly.

Published simultaneously as a low-cost current-awareness tool are *Current Papers*, in the same fields and using the same classification; they provide just titles, authors and bibliographic references.

The abstract journals and *Current Papers* have subscribers in 77 countries—with some 50 per cent of subscribers in the United States alone.

Samples from the range of INSPEC products

Selective dissemination is the growing trend in information services. INSPEC operates an SDI service whereby subscribers have the profile of their needs stored and checked against all incoming information. Individual subscribers' information cards are automatically printed out and despatched weekly. This service is the result of a merger with a pioneer British experiment originally operated by the National Electronics Research Council and extended in 1971 to cover the whole range of INSPEC subjects.

SDI cards contain titles, authors and their organisations, sources and their details, language, classifications, code, item serial number and subscriber's name. With a subscriber's SDI cards a summary card is sent which reiterates his profile, which he can alter and return if his needs have changed. The rates for the SDI service vary according to the number of items which have had to be searched and the resulting number of notifications.

Another new service recently introduced as a low-cost service is the *Topics* system, whereby the computer analyses its input to see what material there is available in selected fields of interest. There are now 48 *Topics* covering such fields as computer-aided design, electronic equipment reliability, thin magnetic films, holography, etc. Data meeting the *Topics* specification is printed out on cards similar to those used for the SDI service and despatched weekly. At the moment, *Topics* and SDI users are mainly British, but the export market is growing. *Topics* are now sold through agents in Holland, USA and Japan.

INSPEC has also been a pioneer in providing a regular service in magnetic tapes, and there are now numerous subscribers in the UK, Japan, the USA, France, Sweden, Hungary and Eire. Two standard tapes are offered, containing either the Current File in its entirety or the more selective current-awareness data base corresponding to the printed *Current Papers*; other special services on tape are available on negotiation. Subscribers can make what use they like of the tapes purchased, and in Canada, for instance, 200 secondary subscribers receive a locally selected information service based on the INSPEC tapes.

Looking to the future, INSPEC is examining the prospects for single retrospective searches of the entire data base. At the moment this would be extremely expensive, and the computer is not programmed for this kind of indefinite selection. But, ultimately, this type of information retrieval is likely to become commonplace, and INSPEC is currently investigating the intracacies of on-line interrogation in conjunction with Queen's University, Belfast.

Already the IEE headquarters in central London houses a terminal linked to the Belfast computer for experimental tests, but the optimum form of this sort of operation has yet to be fully evaluated. However, retrospective retrieval of INSPEC data is available to USA subscribers to the Philadelphia 3i's Company's service, which sells SDI, *Topics* and magnetic tapes through an agency agreement with the IEE.

As to more immediate developments, electronics products and mechanical engineering are possible additions to the INSPEC range of subjects, and the current patent work may be extended for the specific use of international patents organisations. It might also be possible, through co-operation with other information organisations, to link directly with the INSPEC data bank.

The INSPEC research programme embraces the possibility of exploiting other technological advances, including other forms of micro-form information dissemination and the supply of data on-line.

More Information: INSPEC, The Institution of Electrical Engineers, Savoy Place, London WC2R 0BL. Tel: 01-240 1871. Telex: 261176. Cables: Voltampere London WC2.

news

Advisory Committee for Industrial Technologies

A COMMITTEE for Industrial Technologies is to be set up to advise the Department of Trade and Industry on measures necessary to promote greater awareness of a number of multidisciplinary technologies which, if applied to maximum advantage, could, it is estimated, result in savings of up to £1,500 million a year in the manufacturing, service and distribution industries. The Committee will formulate policy on the promotion of industrial technologies as an entity, and co-ordinate action on each of the individual technologies, which at present comprise tribology, terotechnology, corrosion technology and materials handling. The Committees through which DTI already promotes tribology and terotechnology are being reconstituted to become bodies giving expert advice to the new Committee. Similar bodies will be formed to advise the main Committee on corrosion technology and materials handling.

Mr. Gilbert A. Hunt, Managing Director and Chief Executive Officer of Chrysler United Kingdom Ltd., has been appointed Chairman of the main Committee. Dr. H. Peter Jost, Director, Williams Hudson Ltd. and Stothert and Pitt Ltd., who as Chairman of the Committee on Tribology has pioneered much of the work leading up to the decision to promote industrial technologies, will be Deputy Chairman and also Chairman of a small Management Board which is being set up to assist the main Committee. Major-General Sir Leonard Atkinson, Managing Director of Harland Simon Ltd. (part of the Weir Group), Director, Weir Engineering Industries, and Chairman of the Committee on Terotechnology, has been appointed a member of the main Committee.

New survey of information projects published

A new and enlarged edition of *A Survey of Information Projects* has been published by the Department of Trade and Industry. Presenting a catalogue of information-processing activities in the United Kingdom, the publication is the result of a blanket survey during the latter half of 1971 to which some 600 firms and other organisations responded. Heavy emphasis is placed on the storage and retrieval of information by computer process. Details of techniques, languages, data structure, hardware and software used in 565 individual projects are listed under group headings —from accountancy to welding—with an outline of the type of information stored and the broad aim of the information process. Entries are arranged alphabetically under the contributor's name within each subject area. Available from the Department of Trade and Industry, Technology Reports Centre, Orpington, Kent BR5 3RF, price £3. A microfiche version is available at 20p.

Certification of flameproof electrical apparatus

The Safety and Health Division of the Department of Trade and Industry announces new arrangements for the certification of flameproof apparatus in mines:

With the issue of BS 4683: Part 2: 1971 'Specification for Electrical Apparatus for Explosive Atmospheres: The Construction and Testing of Flameproof Enclosures of Electrical Apparatus', the procedure to be adopted in relation to FLP Certification of apparatus designed for use in mines where methane may be a hazard (Group I) will be as follows—

1. Applications are now accepted for certification of any new type of apparatus to BS 4683: Part 2: 1971. Applications may also be made for apparatus currently certified to BS 229 to be re-

certified to the new standard; in the majority of cases a re-test will be required.

2. No applications will be accepted for certification of any new types of apparatus to BS 229: 1957 after September 1, 1972.

3. Applications for supplementary certification to BS 229: 1957 of modifications to apparatus itself currently certified to BS 229: 1957 will continue to be accepted for as long as it is necessary. Manufacturers should, however, consider seeking certification of the apparatus to the new standard, which will, no doubt, be increasingly demanded by users.

4. Applications will also be accepted for supplementary certification to BS 229: 1957 of apparatus itself currently certified to BS 229 in which modifications to the apparatus are designed in accordance with BS 4683: Part 2: 1971. Where apparatus certified to BS 4683: Part 2: 1971 is required to be certified in association with apparatus previously certified to BS 229, supplementary certification will normally be granted to the BS 229 certificate. In cases where the main apparatus to be certified includes attachments previously certified to BS 229, consideration will be given to the issue of a BS 4683: Part 2: 1971 certificate for the complete assembly. Re-testing may be necessary in the case of all applications under this paragraph. The arrangements will be reviewed in five years time.

Moiré-fringe technology conference

A two-day conference on moiré-fringe technology will be held at the Birniehill Institute, East Kilbride, on June 19 and 20, 1972. An introduction for the newcomer will be followed by application papers from the United Kingdom and the Continent, covering the present state-of-the-art and future developments, and outlining applications of optical grating systems in the scientific and technical fields. Special emphasis will be placed on the use of moiré-fringe techniques in numerical control of machine tools. By assembling the leading European authorities on moiré-fringe technology, the conference will provide a forum for exchange of views and ideas, and bring present users of measuring systems up to date with improvements in technique. Associated with the conference will be a small supporting exhibition displaying some of the latest equipment available in industry and at NEL. More information: Conference Organiser, Birniehill Institute, National Engineering Laboratory, East Kilbride, Glasgow. Tel: East Kilbride 20222, ext. 570.

Marine Technology R and D

COINCIDING with the conference Oceanology International 72 held in Brighton in March, the DTI's Committee on Marine Technology has published *Research and Development in Marine Technology*. The 116-page report has been prepared by the Committee and the Marine Technology Support Unit at the UKAEA, and it includes reviews of the Committee's work during the last 2½ years on research and development needs in marine technology, and a digest of R and D proposals. Available from the Technology Reports Centre, DTI, Orpington, Kent, BR5 3RF, price £1.50.

BSRA launches non-marine work

MANUFACTURERS, consultants and other organisations, both marine and non-marine, can now enlist the help of the British Ship Research Association to solve problems. The association is seeking to capitalise on its experience and know-how in the marine field by undertaking additional work on a repayment basis. While much of the demand for its services is expected to be from marine sources, many of the techniques employed in ship research are applicable to non-marine problems. As an example, BSRA points out that instruments which have been used for many years to gather statistical data on the stresses occuring in ships at sea have recently been fitted to a television mast to obtain similar data on the effects of wind; stresses in a crane used for steel handling have been measured by the same methods used on ships; and vibration and noise methods which BSRA applies to ship problems in this field could also be used elsewhere. Further information: BSRA, Wallsend Research Station, Wallsend, Northumberland.

National Computing Centre activities

Value-added tax and the computer

THE NCC has published the first volume of a two-part reference work on value-added taxation. *Computerguide 6: Value-added Tax—Book 1* deals with the general principles of value-added taxation and the implications for computer users, and incorporates the most up-to-date information available at the beginning of February. Typical chapter headings are: VAT working principles; VAT administration details; Interface with the tax authority; Effects of VAT on computer systems; Stationery re-design. Two case studies are also included, together with four appendices for additional material. *Book 2*, to be published about June/July, will contain details of the enabling legislation and information on the unique dialogue now being set up between NCC computer-using members and the tax authority. Book 1 costs £1.50 from NCC, Quay House, Quay Street, Manchester M3 3HU. Tel: 061-832 9731.

Computer education conference

As a step towards creating a National Working Party to serve the future needs of lecturers in Colleges and Departments of Education who are actively engaged in the development of computer courses, or who are interested in the impact of the computer on the educational process, the National Computing Centre is holding a conference at Gipsy Hill College, Kingston-upon-Thames, on July 4 and 5, 1972. More information: Mr. Peter Wheeler, Head of Public Relations, NCC.

Rapid computing service for design engineers

THE National Computing Centre has signed an agreement with Baric Computing Services Ltd., who will operate NCC's RAPID (Resource Allocation and Piping Isometric Drawings) computer package as an exclusive bureau service. The RAPID package is of value to engineers concerned with the design, manufacture and construction of piping in chemical and oil process plant, as it enables a computer to be used to produce isometric drawings and material requirements from details of the plant model or general arrangement drawings.

Market research at the National Materials Handling Centre

Evidence of the interest of the materials-handling industry in learning more about customer requirements for its products is demonstrated by the National Materials Handling Centre's entry into the market research field. The Centre has prepared two reports—one on semi- and fully-automatic palletisers, the other on stacker cranes—which will be of interest to prospective purchasers or manufacturers of palletisers or stacker cranes. The palletiser report is based on information supplied by 150 'user' or 'potential-user' companies and over 20 suppliers. It includes reference to several user comments that 'many suppliers seem unaware of the impact of the Common Market' and that 'many United Kingdom suppliers are too complacent and only interested in selling their present designs'. Also based on interviews with a large number of companies, the stacker-crane report refers to the 'general unawareness of the difficulties which arise after commissioning, resulting in insufficient time and money being budgeted'. It examines the economics of linking stacker cranes to computers for automatic control and the extent to which companies are increasingly concerned with ensuring that their property is re-leasable. More information from: The Director, National Materials Handling Centre, Cranfield Institute of Technology, Cranfield, Bedford. Tel: Cranfield 323.

Steel sheet and plate go metric

THE Metrication Board have published a new free leaflet, *Steel Sheet and Plate*. Steel stockholders can order bulk supplies of the leaflet, IM 1, which is also of particular interest to engineering firms who buy their sheet and plate from steel stockholders. The leaflet sets out the more common standard metric thicknesses for steel sheet and plate and gives the nearest Birmingham Gauge equivalents. These are so close that they are interchangeable for most general purposes. The standard metric widths and lengths are given for mild-steel and galvanised sheet, for alloy sheet and for smaller sizes of plate. Orders for the leaflet, specifying reference number and quantity required, should be sent to the Metrication Board, 22 Kingsway, London WC2B 6LE.

New reflector prism switch

Two technologies are combined in an invention from the National Physical Laboratory—air bearings and laser optics. The device is a compact fast Q-switch for laser beams, which is marketed by Westwind Turbines Ltd, Poole, Dorset, under licence from the National Research Development Corporation. It consists of a prism rotated by an air turbine, and it has other applications in high-speed photography and optical scanning.

The system offers advantages over non-mechanical techniques such as bleachable absorbing filters, absorbing dye inserted in the laser cavity, and electro-optical Q-switches (Kerr cells or Pockels cells). Its cost is comparatively low, and it shows high optical transmission and extremely good homogeneity. It is also said to be superior in its very high resistance to laser damage and freedom from distortion caused by non-uniform temperature.

More information: Where possible, items in *New Technology* indicate the best sources of further information. Readers are advised also to seek information on matters relating to *New Technology* from the following DTI regional offices: Edinburgh, 031-225 1822; Cardiff 62131; Newcastle upon Tyne 27575; Manchester, 061-832 9111; Leeds 38232; Nottingham 46121; Birmingham, 021-643 8221; Bristol 21071; London and South East, 01-684 9781; Eastern, 01-828 4355. In Northern Ireland, information is given by the Dept. of Industrial and Forensic Science, Belfast 21722.

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